On a floating egg mass of the diamond shaped squid *Thysanoteuthis rhombus* (Cephalopoda: Thysanoteuthidae) in the western Mediterranean

Observaciones sobre una puesta pelágica del calamar losange *Thysanoteuthis rhombus* (Cephalopoda, Thysanoteuthidae) hallada en el Mediterráneo occidental

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Recibido el 14-XI-1996. Aceptado el 3-XII-1996

ABSTRACT

This is the second record of a floating egg mass of the diamond shaped squid *Thysanoteuthis rhombus* in the Mediterranean (37° 11.85' N - 1° 31.15' E). The first one was observed at the Strait of Messina in 1929. The egg mass was a dense, resilient oblong cylinder with rounded tips appoximately 100 cm in length and about 20 cm in diameter. From a small sample, egg capsules and paralarvae (1.85±0.08 mm ML) are described. Some complementary characters about this species paralarvae, such as the arm formulae, the presence of an incipient swimming keel-like shaped membrane on some arms, and the mantle chromatophore pattern should assist in their identification.

RESUMEN

En este trabajo se informa sobre el segundo hallazgo de una puesta pelágica del calamar losange *Thysanoteuthis rhombus* en el Mar Mediterráneo (37° 11,85' N - 1° 31,15' E). La primera se observó en el estrecho de Mesina en 1929. La masa de huevos consistía en un cilindro oblongo con los bordes romos, denso y elástico, de unos 100 cm de longitud y 20 cm de diámetro. A partir de una muestra pequeña que se pudo obtener se describen las cápsulas ovigeras y las paralarvas (1,85±0,08 mm ML). Se proporcionan algunos caracteres complementarios útiles para la identificación de estas paralarvas: la formula braquial, la presencia de una carena natatoria incipiente aquillada en algunos brazos y el patrón de cromatóforos en el manto.

KEY WORDS: Cephalopoda, *Thysanoteuthis rhombus*, egg mass, paralarvae, Mediterranean Sea.
PALABRAS CLAVE: Cephalopoda, *Thysanoteuthis rhombus*, puesta, paralarvas, mar Mediterráneo.

INTRODUCTION

The diamond shaped squid *Thysanoteuthis rhombus* Troschel, 1857 is an epipelagic inhabitant of warm tropical and partially subtropical waters of the World Ocean including the Mediterranean, often occurring in pairs or small schools

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(NISHIMURA, 1966; CLARKE, 1966; NIGMATULLIN, ARKHIPKIN AND SABIROV, 1995). It is a large oegopsid squid which reaches up to 85 cm in mantle length (ML) and 24 kg in body weight (NIGMATULLIN *ET AL.*, 1995). *T. rhombus* is one of the fastest-growing squid: in approximately one year, it reaches its maximum ML (NIGMATULLIN *ET AL.*, 1995). This species has high potential fecundity (up to 4.8 million oocytes), but a rather small maximum volume of oviducts (up to 140,000 eggs) and egg masses (35,000 to 75,000), which suggest that *T. rhombus* is an intermittent spawner with multiple filling and evacuation of oviducts (NIGMATULLIN *ET AL.*, 1991; NIGMATULLIN *ET AL.*, 1995).

T. rhombus is one of the few oegopsid cephalopods in which the spawn is known. Until recently, a total of 21 egg masses had been observed. All were found drifting in the surface water layer of the tropical Atlantic, northwest and southeast Pacific and the Mediterranean (review in SABIROV, ARKHIPKIN, TSYGANKOV AND SHCHETINNIKOV, 1987). Egg masses of this species are gelatinous, sausage-shaped, 60-180 cm long by 10-30 cm diameter; containing a double spirally arranged row of eggs embedded in the surface layer of the mass (MISAKI AND OKUTANI, 1976; SUZUKI, MISAKI AND OKUTANI, 1979). The egg mass was photographed in natural environment for the first time by SUZUKI *ET AL.* (1979). The first and unique reference to an egg mass of *T. rhombus* in the Mediterranean (Strait of Messina) was given by SANZO (1929).

Although the occurrence of this species in the Mediterranean is rare (MORALES, 1981; BIAGI, 1982; MANGOLD AND BOLETZKY, 1988) it seems that its presence is increasingly frequent as bycatch in some pelagic fisheries, particularly near the coast (EZZEDDINE-NAJAI, 1996). A pair of animals, male and female, were observed by divers in a submarine cave off the coast of Almeria (Southeast Spain) relatively near the place where the sample reported in this paper was collected (GUERRA, 1992).

This paper deals with the second record of the egg mass of *T. rhombus* in the Mediterranean after 67 years. A description of the planktonic paralarvae is given, emphasising several characteristics which may be used to identify the early stages of the species.

MATERIAL AND METHODS

The egg mass was discovered by the vessel "*Toftevaag*" at 08.27 h on August 27, 1995, at 37° 11.85' N - 1° 31.15' E in the western Mediterranean (Fig. 1). The reported egg mass was accompanied by other drifted pleuston, such as jelly-fish. The whole mass was so loose that it could not be taken out of the water. But a sample of gelatinous material containing 2 eggs in early stage of development, 1 embryo within its egg capsule, 2 paralarvae within the egg capsules, and 32 practically fully developed paralarvae outside the egg capsules were caught. This sample was fixed in 5% formalin. The identification was made based on the paralarvae which, although still embedded in the external gelatinous mass, were near hatching. These paralarvae have similar characteristics to those reported by STEPHEN (1992). Egg diameter, dorsal mantle length (ML) and total length (TL) of each paralarvae were measured using a dissecting microscope fitted with an eye-piece graticule.

RESULTS

The egg mass was a dense, resilient, oblong cylinder with rounded ends (Fig. 2A). The size of the whole mass was about 100 cm in length and about 20 cm in diameter. It was observed that the purple egg capsules lay in two rows, spirally arranged around the cylinder. The diameter of the egg capsules with the well developed embryo ranged from 2.8 to 3.0 mm. The average ML of paralarvae was 1.85±0.08 mm (n= 30) and its TL varied between 2.50 and 2.75 mm.

All paralarvae observed had the head inside the mantle cavity, only showing the arms and tentacles exter-

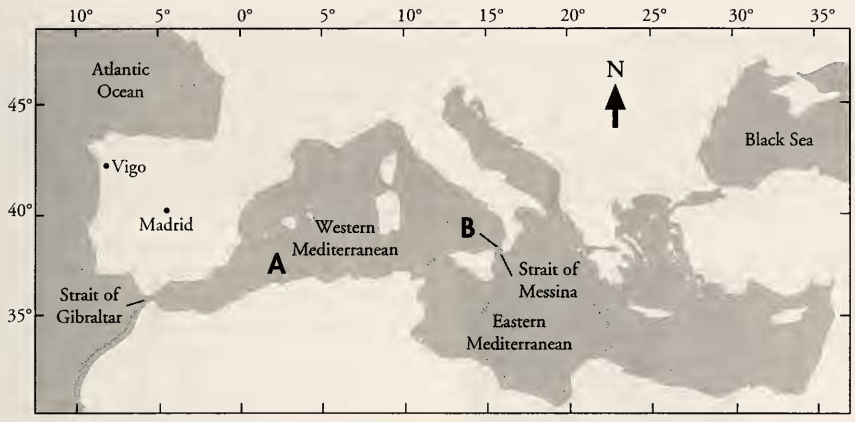

Figure 1. *Thysanoteuthis rhombus.* Location of the two floating egg masses collected in the Mediterranean Sea. A: This paper; B: SANZO (1929).
Figura 1. Thysanoteuthis rhombus. *Localización geográfica de las dos puestas pelágicas encontradas en el Mar Mediterráneo. A: Presente estudio; B: SANZO (1929).*

nally (Fig. 2B). The mantle is oval, stout, short and blunt posteriorly. The anterior margin of the mantle curves inwards in both dorsal and ventral sides, but is more pronounced ventrally. This may be a result of the preservation process which could had produced the retraction of the head inside the mantle cavity. The fins are subterminal, small and rounded; the fin length 19.5% ML (Figs. 2C, D). The paralarvae have broadly separated, slightly protruding eyes, and funnel locking cartilage (Fig. 2E) with a short, broad, transverse groove and a long, relatively wide, longitudinal groove (sideways ⊦shaped). The tentacles are short (about 33% of the ML), stouter and slightly longer than the longest arm (III); the I and IV pairs of arms are rudimentaries. Brachial formulae III>II>I=IV. Both, tentacles and developed arms, with small suckers, probably arranged in two rows. On arms II and III, an incipient swimming keel-like shaped membrane was present. Trabeculate protective membrane was absent in arms and tentacles.

The paralarvae show two types of chromatophores: a) large and pale-ochre chromatophores densely concentrated on dorsal, lateral and ventral mantle sides; and b) small, subtriangular dark-red chromatophores arranged in a single row around the anterior margin of the mantle. There is a light area between both types of chromatophores. Slight chromatophores were observed on the dorsal and ventral sides of the head, the tentacles and the arms. The fins lacked chromatophores.

DISCUSSION

The egg mass reported was captured near the surface in a zone were the inflow of Atlantic water into the Mediterranean is high due to the proximity of the Strait of Gibraltar. The water movements through this bottleneck are governed by an inflow of surface water into the Mediterranean, and a countercurrent of lesser volume carrying water of higher salinity into the Atlantic (MANGOLD AND BOLETZKY, 1988). The egg mass collected by SANZO (1929) was in the Strait of Messina where there are strong currents. Elsewhere egg masses of *Thysanoteuthis rhombus* occurred in regions with strong warm currents such as Kuroshio, Perú countercurrent and the Equatorial countercurrent (YAMAMOTO

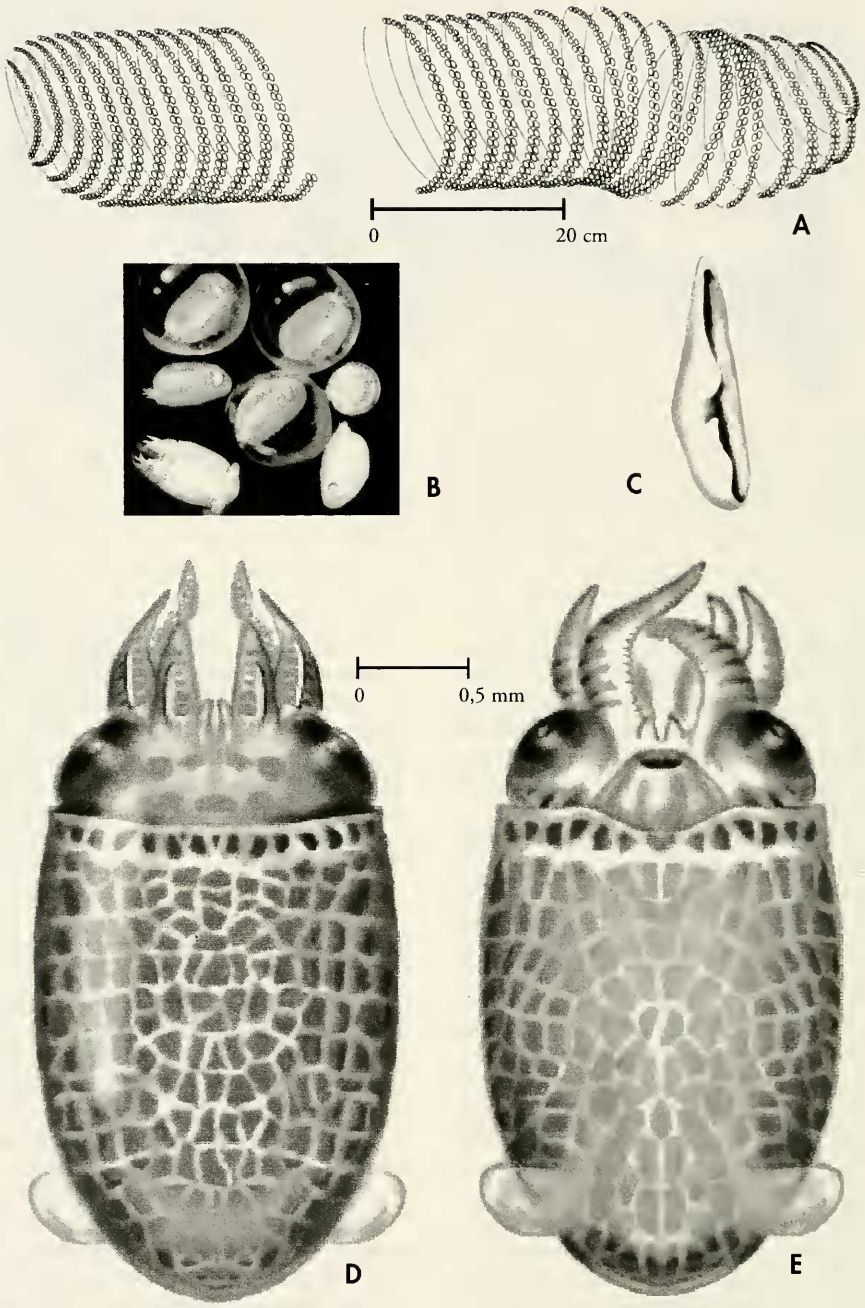

Figure 2. *Thysanoteuthis rhombus.* Floating egg mass and paralarvae. A: egg mass; B: Egg with non-developed embryo and paralarvae within the egg capsule; C: Funnel locking-cartilage of a newly hatched, 1.85 mm ML; D: Dorsal view of a newly hatched, 1.85 mm ML; E: Ventral view of the same specimen.
Figura 2. Thysanoteuthis rhombus. *Puesta pelágica y paralarva. A: Puesta pelágica; B: Huevo con embrión muy poco desarrollado y paralarva dentro de la cápsula ovígera; C: Cartilago de cierre en el sifón de un recién nacido de 1,85 mm ML; D: Visión dorsal de un recién nacido de 1,85 mm ML; E: Visión ventral del mismo ejemplar.*

AND OKUTANI, 1975; NIGMATULLIN *ET AL.*, 1995). Therefore, as in the Atlantic and the Pacific Oceans, in the Mediterranean the species seems to spawn in waters with strong currents.

NIGMATULLIN *ET AL.* (1995) indicated that *T. rhombus* spawns throughout the year in tropical waters, but during the warm season (summer and early autumn) in peripheral regions such as in the Mediterranean, which agree with the date when the egg mass reported was observed.

The egg mass in the report had a shape and a size which coincide with those given for the other egg masses illustrated (SANZO, 1929; MISAKI AND OKUTANI, 1976) and photographed (SUZUKI *ET AL.*, 1979).

Considering the dimension of this egg mass, the diameter of the egg capsules measured and calculating the surface of the egg mass as a cylinder (6,280 cm^2), an estimation gives a figure of about 66,800 eggs. This amount coincides with the total number of eggs in each egg mass calculated by SABIROV *ET AL.* (1987) which ranged from 32,000 to 76,000 eggs.

The embryo and paralarvae found have sizes, shapes and characters which largely coincide with those reported by ISSEL (1920), SANZO (1929) YAMAMOTO AND OKUTANI (1975) and MISAKI AND OKUTANI (1976) and summarised by CLARKE (1966) and STEPHEN (1992). Some complementary information about this species paralarvae, such as the arm formulae, the presence of an incipient swimming keel-like membrane on some arms, and the mantle chromatophore pattern should assist in their identification.

ACKNOWLEDGEMENTS

We are particularly grateful to Ricardo Sagarminaga and Ana Cañadas, owners of the Vessel "*Toftevaag*" and promoters of the "Alnitak" project for the specimen collection. We thank Diego Moreno of the University of Almería for valuable preliminary comments on the sample and Alfredo López "Tokio" for drawing the egg mass and paralarvae figures. We are grately indebted to Prof. T. Okutani, Dr. P. G. Rodhouse and Dr. A. F. González for valuable suggestions on the manuscripts. Our thanks also to Ian Emmett for reviewing the English text.

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